OBSERVATIONS ON LARVAL AND PUPAL HABITS OF THE JUNIPER CONE MOTH, PERIPLOCA ATRATA HODGES

(Lepidoptera: Gelechioidea)

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Members of the genus *Periploca* Braun are small, dark, shiny moths which are poorly known biologically. The species for which some information is available exhibit a variety of habits as borers in different woody plants. In his recent treatment of the genus, Hodges (1962) described *P. atrata* from specimens collected in the Santa Rita and Chiricahua Mountains, Arizona, and at Mt. Diablo, Contra Costa County, California. Among material examined by Hodges were specimens reared from fruit of *Juniperus pachyphloea* in Arizona and *Juniperus californica* at Mt. Diablo.

Collections from the latter area made during the spring of 1962 have produced some further information on the biology of this moth which is of interest, especially the characteristic emergence arrangement. Juniper was examined for affected ovulate cones at 2900 feet elevation on Mt. Diablo, January 21 and at Russelmann Park, located at 1100 feet on the north slope of the mountain, February 23 and again on April 6 and 13. In January and February although numerous berries were examined which showed brown spotting, were turning purple, or had a shriveled appearance, the few discovered containing *Periploca* showed no apparent correlated external effects. By April, however, infested fruits had a noticeable pale, wrinkled appearance and were found to be rather common on some trees.

Larvae of *P. atrata* were present in the January 21 and February 23 lots, although most individuals had pupated by the latter date. Feeding took place within the seed in a curling tunnel and eventually consumed most of the volume of the seed, but left the pulpy, fibrous outer cover essentially untouched. Variation was noted in disposition of the frass. Evidently much of the frass from younger larvae was expelled, since essentially frass free tunnels were observed. In one instance a tiny hole was present at a point where the tunnel touched the berry skin, while another larva was found in a clean burrow which led to a large round hole; yet in still another case some frass was found in a larval excavation which seemed to have no opening to the exterior. Feeding by mature larvae resulted in an accumulation of frass around the pupal cham-

ber, and in all cases this was noted to be considerably more than was associated with any larva seen.

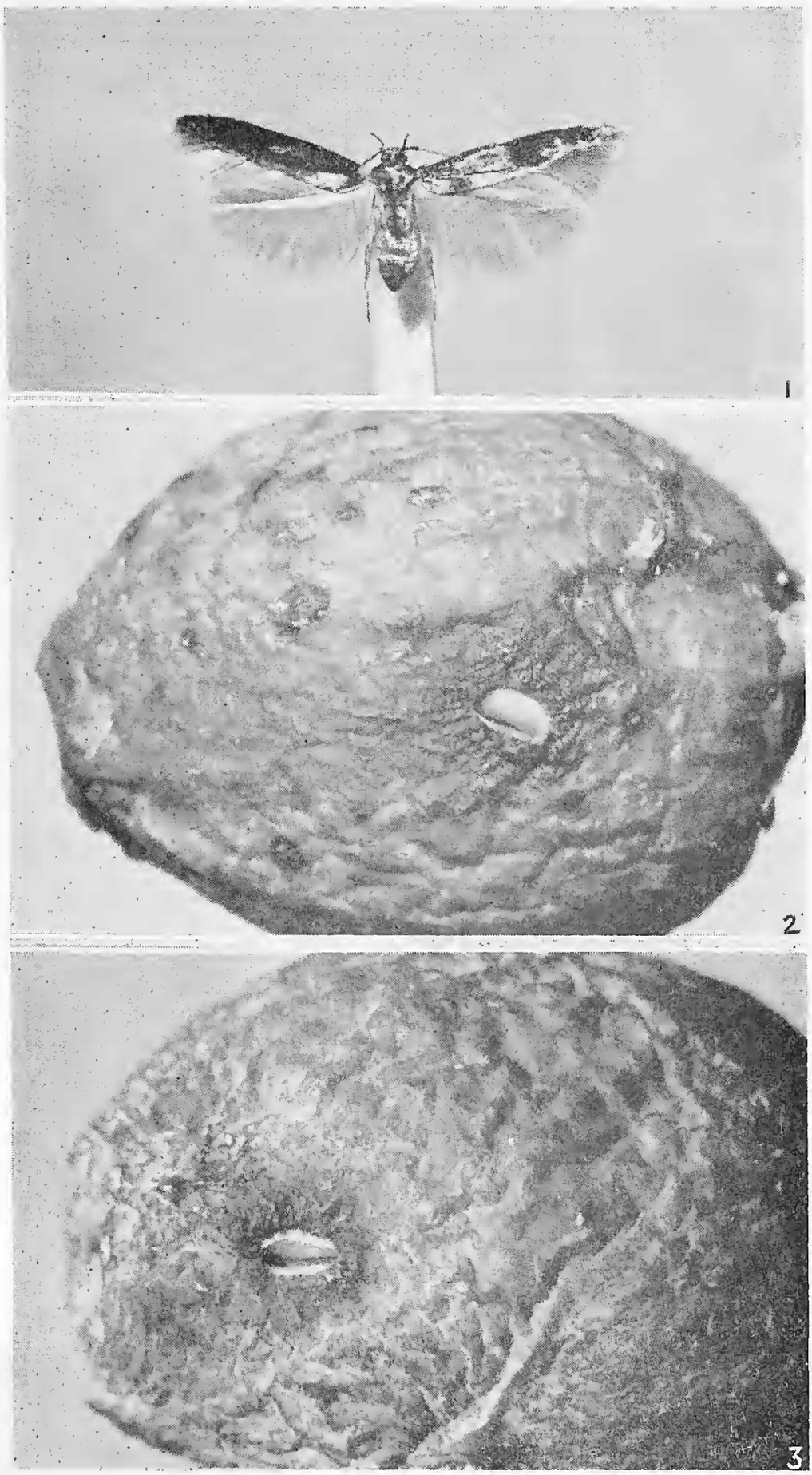
The presence of pupae within cones was always to be perceived from the external appearance of the emergence aperture. The hole was closed by a curious valve-like structure (Figs. 2, 3), evidently of silk origin, but exteriorly of a tough, smooth, leathery consistency. The apertures were oval and measured about 1.1 x 0.6 or 0.7 mm, and each was accompanied by a darkened area about twice that size surrounding it. Beneath the valve closure a silken tube trackway led away from the exit some distance around the seed, then into the pupation chamber inside the seed. In most cases the exit path comprised a full 180° turn from the direction of the pupal situation, and at times curved away from its plane by as much as 90°. At emergence the pupal shell, which has no cremaster, remained *in situ*, probably held by the tight confinement of the pupal chamber and the constricted exit trackway. When the emerging moth reached the surface, it caused the sides of the "valve" to part, evidently by forcing the sides of the silken trackway apart, pulling the exit cover inward. The apertures remained open after emergence of the moths, and such berries were easily distinguished from those with pupae still inside.

Cosens (1908) made no mention of any such closure of the emergence hole of *Periploca ceanothiella* (Cosens), a gall-maker in branches of *Ceanothus*. However, he noted that galls occupied by overwintering larvae were lined with silk. *P. atrata* seemed not to form any silk lining within the juniper cones other than the emergence trackway.

Whereas during early spring painstaking search was necessary to reveal the presence of emergence valves or frass ejection holes, by April affected berries had a distinctive appearance which enabled almost unerring selection of them from among healthy ones. In addition to the exit valve, cones containing pupae had by this time a pale, slightly yellowish, and slightly wrinkled appearance in comparison to normal, smooth green fruits. Berries with a conspicuous brown spot, which were common on the trees, were not

Explanation of Figures

Fig. 1, *Periploca atrata* Hodges, female (3.5X); Russelmann Park, Contra Costa County, California, II-23-62, reared from *Juniperus californica* berry, emerged III-16-62 (JAP-62B8). Figs. 2-3, ovulate cones of juniper (8.2X) showing exit aperture "valve" of *P. atrata* prior to emergence.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found to contain pupae, but at times pupae were found in cones having a purplish tinge. This led to an examination of purplish fruit from the ground under a tree, but none were discovered with signs of *Periploca*. The fact that nearly mature pupae within greenish berries were found on the trees in April suggests that affected fruits normally do not drop prior to the moths' emergences.

Apparently larval feeding is completed and pupation occurs well ahead of emergence. One teneral pupa was collected January 21, even though a light snow was falling at the time, and Mt. Diablo recorded its coldest temperature of the season (10°F) the following day. This individual emerged about three weeks after being brought into the laboratory, as did those collected as pupae in late February. However, moths were not seen at Russelmann Park by April 13, and no emergence had occurred from observed berries. Hodges (1962) gave a record of *P. atrata* taken at Mt. Diablo, April 5, 1937 (by E. C. Van Dyke), presumably as adults; and moths emerged from my April 13 collection between April 16 and 19, indicating that the flight period probably occurs in April and early May. This is somewhat earlier than that of *P. ceanothiella* (Cosens) and *P. nigra* Hodges (a cambium miner in ornamental juniper) in the area. Records of specimens taken at lights in Walnut Creek near Mt. Diablo during 1961 and 1962 indicate that both these species fly during the last week of May and in June. The latter species was taken as late as July 10. Adults of all three species are presumed to be noctural in behavior. Those of *P. atrata* emerged at night and remained quiescent during the daylight hours when housed in petri dishes.

Two specimens of an ichneumonid, *Pristomerus* sp.[1], were reared from the 1958 collection (Russelmann Park, I-4-58, H. Ruckes, Jr.) reported by Hodges. The specimens emerged from unsegregated berries, and no specific data were taken regarding the host-parasite relationship. No parasites were obtained from the 1962 collections.

Acknowledgment is made to R. W. Hodges, U.S. National Museum, who determined specimens of the three species of *Periploca*.

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[1] Determined by G. S. Walley, Entomology Research Institute, Ottawa, and deposited in the Canadian National Collection.

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1908. A new lepidopterous gall-producer. Canadian Ent., 40(3): 107-108.

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BOOK REVIEW

BUTTERFLIES OF THE AMERICAN TROPICS. THE GENUS ANAEA.

By William Phillips Comstock. The American Museum of Natural History, New York, 1961. Printed in England, W. S. Cowell, Ltd., Ipswich. xiii + 214 pp., 30 colored plates. Price $25.00 cloth.

An aura of Old World nineteenth century splendor strikes one on leafing through this magnificently executed volume, with its heavy paper, broad margins, widely spaced lines of large, clear type, and its generously spaced fine colored reproductions. The work was begun over 20 years ago and carried out by the author with the enthusiastic interest and financial support of Mr. Frank Johnson of Griffin, Georgia. The manuscript was completed in 1949 following a preliminary paper on the Antillean species by Johnson and Comstock. As stated by Dr. F. H. Rindge in the preface to the present book, it is indeed unfortunate that neither of the persons primarily responsible for it lived to see the work finally printed. The book is undoubtedly one of the finest treatments, both in its scientific and mechanical aspects, to have been published on Neotropical Lepidoptera. The manuscript and plates have been edited and rearranged since the death of Dr. Comstock, but according to Rindge the text is virtually as originally written.

The work itself is a study of the species formerly assigned to the genera *Coenophlebia, Siderone, Zaretis, Hypna, Anaea, Polygrapha, and Protogonius* (=*Consul*), all of which are treated as subgenera. The group comprises some 120 species (with 38 additional subspecies), about four-fifths of which are included in the new subgenus *Memphis*. Six species and five subspecies, all members of this subgenus, are described as new. In addition to the rearrangement of the genera and the new forms, evidently considerable taxonomic change also has occurred through new synonymy, which, however, is not designated as such. Besides the systematic account, treatment of the following aspects of the genus *Anaea* are included: immature stages, distribution and origin, climates and population density, paleoclimates and paleogeography, phylogeny, etc. The taxonomic treatment is modern throughout; the classification is based on wing venation, wing shape, and genital morphology of the males and includes consideration of seasonal forms and geographical variation. All phases are illustrated by 250 line figures and maps as well as by the truly excellent colored plates. Artwork for the latter was done by Miss Marjorie Statham and Miss Dorothy Fitchew and depicts both upper and lower wing surfaces of 268 individual butterflies.